

if

$$1 - \cos \phi = \frac{1}{2a} (FM + FM + MN) = \frac{2}{(\varrho + \sigma)^2} \{ \varrho(\sigma + \varrho) + k(\sigma - \varrho) + 2\Lambda \},$$

$$1 - \cos \phi' = \frac{1}{2a} (FM + FN - MN) = \frac{2}{(\varrho + \sigma)^2} \{ \varrho(\sigma + \varrho) + k(\sigma - \varrho) - 2\Lambda \}.$$

In fact we then have also

$$1 + \cos \phi = \frac{2}{(\varrho + \sigma)^2} \{ \sigma(\sigma + \varrho) - k(\sigma - \varrho) - 2\Lambda \},$$

$$1 + \cos \phi' = \frac{2}{(\varrho + \sigma)^2} \{ \sigma(\sigma + \varrho) - k(\sigma - \varrho) + 2\Lambda \},$$

and thence

$$\sin \frac{1}{2} \phi = \frac{1}{\varrho + \sigma} (\sqrt{\varrho(\varrho + \sigma - k)} + \sqrt{k\sigma}), \quad \sin \frac{1}{2} \phi' = (\sqrt{\varrho(\varrho + \sigma - k)} - \sqrt{k\sigma}),$$

$$\cos \frac{1}{2} \phi = \frac{1}{\varrho + \sigma} (\sqrt{\sigma(\varrho + \sigma - k)} - \sqrt{k\varrho}), \quad \cos \frac{1}{2} \phi' = (\sqrt{\sigma(\varrho + \sigma - k)} + \sqrt{k\varrho}),$$

whence

$$\sin \phi = \frac{2}{(\varrho + \sigma)^2} \left\{ \sqrt{\varrho\sigma} (\varrho + \sigma - 2k) + \frac{(\sigma - \varrho) \sqrt{\Lambda}}{\sqrt{\varrho\sigma}} \right\},$$

$$\sin \phi' = \frac{2}{(\varrho + \sigma)^2} \left\{ \sqrt{\varrho\sigma} (\varrho + \sigma - 2k) - \frac{(\sigma - \varrho) \sqrt{\Lambda}}{\sqrt{\varrho\sigma}} \right\},$$

$$\text{and } \therefore \sin \phi - \sin \phi' = \frac{4(\sigma - \varrho) \sqrt{\Lambda}}{(\varrho + \sigma)^2 \sqrt{\varrho\sigma}},$$

$$\sin \frac{1}{2} (\phi - \phi') = \frac{2k\Lambda}{(\varrho + \sigma) \sqrt{\varrho\sigma}}, \quad \cos \frac{1}{2} (\phi - \phi') = \frac{\varrho + \sigma - 2k}{\varrho + \sigma},$$

$$\text{and } \therefore \sin (\phi - \phi') = \frac{4(\varrho + \sigma - 2k) \Lambda}{(\varrho + \sigma)^2 \sqrt{\varrho\sigma}},$$

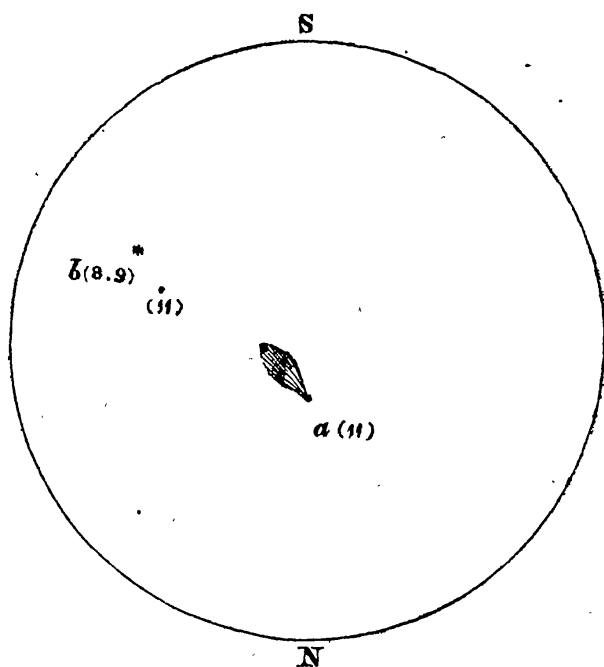
which verifies the formula.

On the missing Nebula in Taurus, on Comet II. 1861, and on Mountain Attractions. By M. O. Struve.

(Communicated by the Astronomer Royal.)

In the month of December we were informed by letters of Prof. d'Arrest's important observation, that the Nebula dis-

covered by Mr. Hind in the constellation of *Taurus* had disappeared. In the first favourable night, 1861, Dec. 29, we directed our large refractor upon the object, and in the first moment thought that its faintness exceeded even the power of our instrument; but, after some minutes, when the eyes had sufficiently adapted themselves to the darkness, we distinctly recognised some traces of nebulosity to the south of a star of 11th magnitude. Mr. Winnecke, whose assistance I had asked on this occasion, agreed with me entirely about the position of this nebulosity. The line joining it with the star of 11th magnitude made an angle of 15° f.f. with the line drawn from that star to another star of 11th magnitude, visible in the same field at a distance of $4'$ south preceding. The distances of the brightest part of the Nebula from the first-mentioned star was estimated by me = 0.22 , by Dr. Winnecke = 0.15 of the distance of the two stars, or about $50''$. Since then we had for nearly three months' very unfavourable weather, and it was only in the night of March 22 that I thought there was a good opportunity for inspecting again that object. My expectation was not deceived. On the first glimpse the Nebula appeared considerably brighter than it did in December, so that it even bore a feeble illumination of the wires. On measuring the direction from the star *a* (see accompanying sketch), I found it $213^\circ.2$, while that of the star *b*, mag. 8.9, was $223^\circ.6$.



As the other small star which had served for comparison on Dec. 29, has nearly the same direction as *b*, this observation

confirms perfectly the estimation made on that former occasion. On March 22 I thought I could trace the nebulosity from the star α as far as one-third of the distance from α to b , or about $1'7$; but it was broader and more conspicuous nearer to α . There again it had the appearance as if on its extreme southern end there was a point of more concentrated light, which made the impression of being another extremely faint star, between which and the star α the Nebula extended the whole length. The sketch will give a general idea of what I saw. Also on this evening my observation was controlled by the sharp eye of Dr. Winnecke.

The facility with which I saw the Nebula in March, compared with the difficulty of the first observation, made upon me the impression as if in the interval the brightness of the Nebula had considerably increased; but this impression is probably in a great part due to the extraordinary transparency of the atmosphere we enjoyed in the month of March.

It will be remembered by the readers of the *Monthly Notices*, that my observations made in 1857 on the great Nebula of *Orion* had left with me the impression as if certain parts of its central region was subject to rapid changes of light. An extensive memoir containing the full account of my observations on this subject is nearly ready for distribution. It will be seen then that all the later observations have confirmed the first impression. The analogy between these observations and the recent discovery of Prof. d'Arrest is conspicuous; but a direct confirmation of my observation by an experienced observer established in a more southern position, and provided with sufficient optical means, is nevertheless very desirable. In this respect I hope Mr. Lassell's new expedition to Malta will afford results of a decisive character.

The extraordinary transparency of the atmosphere during the month of March afforded me the opportunity of making a series of observations of the great Comet of last year (II. 1861), which, I trust, will offer a good normal position for this epoch. These observations bear the date of March 20, 21, 22, 25, and 28; the first observation was made in my absence by Dr. Winnecke; the others by me.

In the present month I have got until now only one determination on April 16, but I hope to get some more observations before the moon returns. The next month the midnight twilight will be too bright in our northern latitude to allow any observation of such a faint object; but in southern climates it might be yet observed some weeks more. With this view I subjoin here an Ephemeris computed by Mr. Liasser from ten to ten days, for the months of May to August, which, in the hands of Mr. Lassell or Mr. Bond, might prove useful:—

ob Berlin M.T.	Comet's R.A. ^h ^m	Comet's Decl. ^o	Log r.	Log Δ.
April 30	22 34 ¹	76 51 ¹	0.648	0.673
May 10	22 55 ²	79 7 ³	.657	.684
20	23 17 ⁹	81 18 ⁴	.667	.694
30	23 43 ⁸	83 24 ⁰	.676	.704
June 9	0 16 ⁵	85 23 ¹	.685	.713
19	1 8 ⁹	87 13 ⁶	.694	.722
29	3 32 ⁸	88 43 ⁸	.702	.730
July 9	9 10 ³	88 36 ⁸	.710	.737
19	11 9 ³	87 15 ⁸	.718	.743
29	11 57 ⁹	85 50 ⁹	.726	.749
Aug. 8	12 29 ⁶	84 21 ⁸	.734	.754
18	12 56 ¹	83 9 ⁰	0.741	0.758

This Ephemeris shows that about July 1 the Comet will approach the north pole within a degree, a circumstance that, it appears, will complicate a little the reduction of the observations, if such should succeed about that time.

In the month of August the nights will be here again sufficiently dark to admit a look-out for the Comet, though the hope of seeing it distinctly at that advanced period is rather small. At present the distance of the Comet from the Sun and Earth is about 4.5 (the same as the large Comet of 1811 had when it was rediscovered by Wisniewsky, in the summer of 1812); but in August it will be about 5.6. Hence it follows that, taking $\frac{1}{r^2 \Delta^2}$ for the coefficient of its light, this will be about 2.2 times less than it is now. On the other hand there is a strong suspicion, as already Prof. Schönfeld has pointed out, that the intensity of light of this Comet is subject to considerable variability, and this circumstance might, perhaps, favour a rediscovery. This suspicion has now some confirmation by my last observation. In one night it hardly bore any illumination of the field, while in other nights it could be distinctly seen even when the bright wire crossed it. But even in these nights I preferred using the method of celestial triangulation which rendered me such good service at the first appearance of Faye's Comet. On April 16 the diameter of the Comet was estimated about 40". Its light is, even in its present faint state, not quite uniform, but shows distinctly traces of concentration.

Mr. Seeling's last elements of the Comet's orbit in No. 1347 of the *Astronomische Nachrichten*, which have served also for Mr. Liasser's Ephemeris, appears to be already very exact. A preliminary reduction of some observations has given the following differences:—

B

	In R.A.	C. — O.	In Decl.
March 20	—6 ^s .6		+0 ^m .1
„ 21	—5 ^s .0		0 ^m .0
„ 22	—7 ^s .6		+0 ^m .4

Hence we must conclude that also the period of 419.5 years, assigned to this Comet by Mr. Seeling, is very nearly exact; but, of course, the last observations, and yet more those that might be made in the next months, will very efficaciously contribute to inclose the uncertainty of the period into narrower limits. This expectation will for itself be a sufficient stimulus for astronomers to spend some trouble on a most prolonged observation. But I think the interest attached to this Comet is yet considerably increased by the consideration that the observations made about the time of its greatest proximity to the Earth, if rigorously reduced, might well serve to deduce at least a confirmation, if not a possible correction, of the Sun's parallax. With this view a strict and critical examination of all existing observations and a most uniform and exact determination of all the comparison-stars would be a necessary condition of success. In the last part of the work the Observatory of Pulkowa will be glad to co-operate if there is only some prospect that any astronomers will undertake the laborious task of working out the results systematically.

Three weeks ago I received interesting news from General Chodzko, the Surveyor-general of our Caucasian provinces. This distinguished officer had been engaged last year with a junction of the triangles measured under his direction to the south of the Caucasus with the geodetic operation in the southern part of European Russia. The chain of triangles measured for this purpose crossed the Caucasian mountains almost at right angles, and I suggested to him the idea of using this favourable opportunity for collecting new and exact data concerning the attraction of large mountain masses. Accordingly General Chodzko selected six stations, situated on both sides of the mountain chain, upon which exact determinations of latitude were to be made. These stations were,

1. Tifis, about 70 miles south of the central line of mountains.
2. Douchet, „ 35 „ „
3. Kobi, very nearly on the central line.
4. Wladikawkas, about 35 miles north of the central line of mountains.
5. Alexandrowskaja, „ 55 „ „ „
6. Mosdok, „ 70 „ „ „

On these stations the observations for latitude were executed by Capt. Oblomievsky, the designated Director of the

Observatory of Tiflis, which next year will begin its astronomical activity.

These observations were not yet entirely reduced when General Chodzko wrote me, and it will be particularly regretted that the results for the central station Kobi are not yet at hand. For the other stations General Chodzko gives the following results, which will be exact within a second. Supposing the latitude of Tiflis to be not affected by local attraction, and designing by ϕ the latitude as determined by direct astronomical observations on each station, and by ϕ' the latitude of the same station when deduced geodetically from that of Tiflis, with Bessel's elements of the Earth's figure, we have

For Douchet $\phi' - \phi =$	$+ 25.1$
Wladikawkas	$- 28.6$
Alexandrowskaja	$- 12.0$
Mosdok	$- 5.6$

Whoever knows a little the geography of the country will agree that it is much more probable that Mosdok is less affected by local attraction than Tiflis. Therefore, attributing the whole amount of $\phi' - \phi$, as found for Mosdok, to the effect of local attraction on the direction of the plumb-line at Tiflis, we shall have

For Tiflis $\phi' - \phi =$	$+ 5.6$
Douchet	$+ 30.7$
Wladikawkas	$- 23.0$
Alexandrowskaja	$- 6.4$

The latitudes of Douchet and Wladikawkas being respectively $42^{\circ} 5'$ and $43^{\circ} 1'$, we have here as the effect of mountain attraction, on an arc of only $56'$, a difference between the geodetic and astronomical arc of not less than $53''.7$; and the diminution of the quantity for Tiflis and Alexandrowskaja shows that the effect, as it ought to be, is there less approximately in proportion of the square of the distance from the principal chain of mountains. How far those differences answer the real attraction of the mountain masses will be the object of future inquiries, but even now it might be presumed that the result for the Caucasus will stand in some degree at variance with that obtained by the Indian triangulation for the Himalaya; so that the ingenious hypothetical explanation given by Mr. Airy for the apparent defect of attraction in those mountains will hardly meet with a satisfactory confirmation in the special case of the Caucasus. I have no doubt General Chodzko will continue these interesting researches with all the power he can command, and thereby furnish most precious results both for

and by observation 2d,

II. 115	R.A.	^h 12	^m 22	^s 12.9	N.P.D.	[°] 75	['] 34	["] 53
II. 116	„	12	22	27.9	„	75	37	53

and taking the means,

II. 115	R.A.	12	22	14.1	N.P.D.	75	32	43
II. 116	„	12	22	29.1	„	75	35	43

The middle point between which differs from the place of (B) by only 19^s.4 in R.A. and 2' 11" in P.D.; so that it is very certain that, had both the objects remained in their places, they must have been in the field of view of a telescope directed on (B).

M. d'Arrest's telescope has amply sufficient power to have shown the missing Nebula (the fainter of the two in all probability, or H. II. 116), which had sufficient illumination to be characterised as "resolvable," and as "pretty bright," or a full second-class Nebula.

Most unfortunately I find no observations of either of these Nebulæ in my reviews of the Nebulæ. They occur in a very rich region of the heavens; but by taking 6 *Comæ* as a guide, there can be no difficulty in setting a telescope upon the place; and I strongly recommend the point for re-examination.

Collingwood, April 4th, 1862.

Opposition of Mars, 1862. By Lieut. J. M. Gilliss, Director of the U.S. Naval Observatory, Washington.

The co-operation of astronomers is invited in a series of observations upon the planet *Mars*, near the opposition of the present year. Differential measures with the stars designated in the accompanying Ephemeris, will be made at the U. S. Naval Observatory, from 27th August to 7th November, 1862. They will be commenced at one hour before the transit of the planet over the meridian of Washington, and be continued during two hours, the measures being repeated as frequently and as rapidly as is consistent with the utmost care. The comparisons will be confined exclusively to the star selected for the night, and it will be referred to the north and south limbs of the planet at alternate measures, the time at which the planet's limb is observed being noted to the nearest tenth of a second. Both objects will also be observed with the meridian instruments, and their difference of declination will be measured with the micrometer-screw of the circle-telescope.